Individual Lab Report #5

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Wholesome Robotics (Team E)

Teammates: Aman Agarwal, Dung Han Lee, John MacDonald, Aaditya Saraiya

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Individual Progress

In the past few weeks I have worked primarily on the electrical wiring of the robot.

Our overall plan is based on the design of the previous Robotanist model, which we intend to roughly duplicate, with modifications for our own applications. We were given a high level electrical schematic as well as a CAD model of the original robot. However, we do not have a complete Bill of Materials for the robotanist, on top of which our documentation does not list the individual parts by part name or number, so I have been continually researching the parts needed. Using terminal blocks and their associated bridging connectors, we can make power distribution nodes that safely connect multiple wires.

I used these distribution nodes to power four DC-DC converter/regulator crating 5V, 12V, 15V, and 19V buses. Each uses an appropriately rated fuse (calculated by peak usage of the bus), and connects to another distribution node that constitutes the physical bus. This also connects the sensing lines of the regulators, which provides feedback to the regulators to maintain a steady voltage regardless of loading. I have also worked on finding and purchasing a 15V→19V buck converter to power the Zotac, which operates only at 19V and at an unexpectedly high current (11.8A). This will connect to the 15V bus (instead of the battery directly), because that bus is otherwise unused, has a large current capacity, and the buck converter cannot handle the fluctuating voltage of the battery.

I have succesfully tested each of the buses, and even powered a few of the components that will be attached to these buses, using the benchtop power supply to simulate the battery.

Finally, I used even more terminal blocks to connect the power and E-stop connections for the hebi motor controllers. This included crimping connectors, and jerry-rigging a temporary E-stop switch.

I also was the point person for purchasing and receiving supplies and parts and with Phipps Conservatory, where we performed a field test. After first replanting a few of the kale plants (to give us more space) we began testing in row navigation, and determined that the kale were too short to be sensed by our lidar. As a result, we changed our Spring Validation Demonstration to be in a different location, and I ordered fake plants that will be used to simulate the rows of plants.

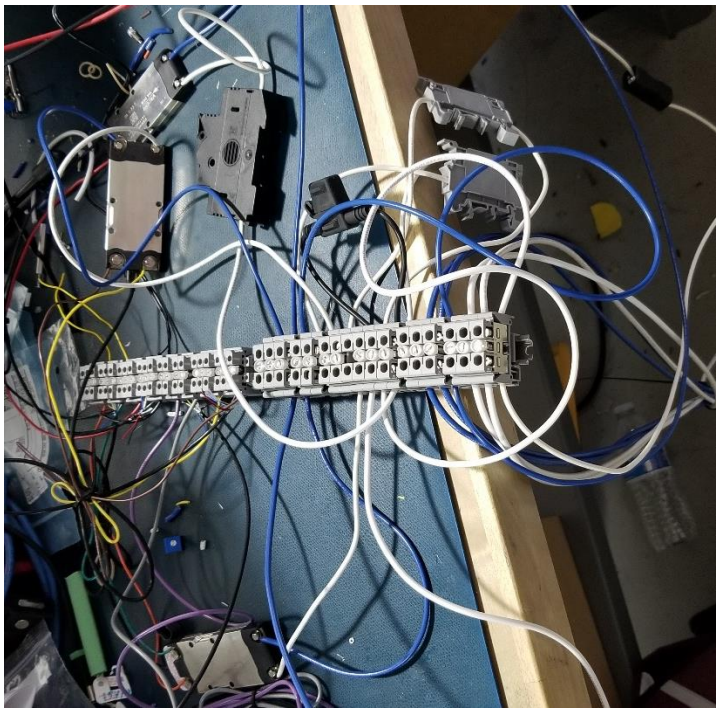

Figure 1 Benchtop Wiring with DIN Rail (still in progress)

Challenges

A major challenge I had in the past few weeks was determining the correct parts for the robot's electrical system and wiring them. I do not have a strong electronics background, so I have needed to spend a lot of time researching terminology, so that I can begin to reverse engineer the existing robot. To address this, I have been in constant contact with the designer of the original robotanist. Additionally, the wiring is rather time consuming and so I was unable to do many other tasks as a result.

Teamwork

Aman has developed the robot's turning planner so that it can programmatically find a way to traverse each row, once in each direction. He is next working on tuning the drive control parameters, and potentially including some sort of dynamic tuning to account for the differences in handling caused by soil variation.

Aaditya has been working on the Sensor Fusion algorithms. He has created some visualization tools and is in the midst of designing the algorithm. It will incorporate the visual odometry and the lidar (point cloud) data.

Dung Han has been working on the perception algorithm for recognizing holes and disease in the plants' leaves. He changed the classification metrics to a reference scale with three options (based on the coverage ratio of the disease/holes) and retrained the network. The results are much better, but they still fail to account for edge cases such as unusual looking fungi and poor contrast images.

John has been working on developing the navigation subsystem. He has implemented the particle filter and is now working on the measurement model for it.

Together we have worked on our business course assignments.

Future Plans

Wholesome Robotics

In the coming weeks my plan is to finish the electrical assembly of the robot's electrical system. The main setup is complete, thought there are many features that still need to be completed before we can run the entire system off of the distribution system. I will also begin work on the mechanical parts that support the electrical systems. By necessity, my approach has shifted from ordering everything first and then assembling, to ordering parts as I discover I need them; this is necessitated by the gaps in previous documentation.

I will also be soldering fan controller PCBs.